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THE BLUEBERRY IN THE ATLANTIC PROVINCES

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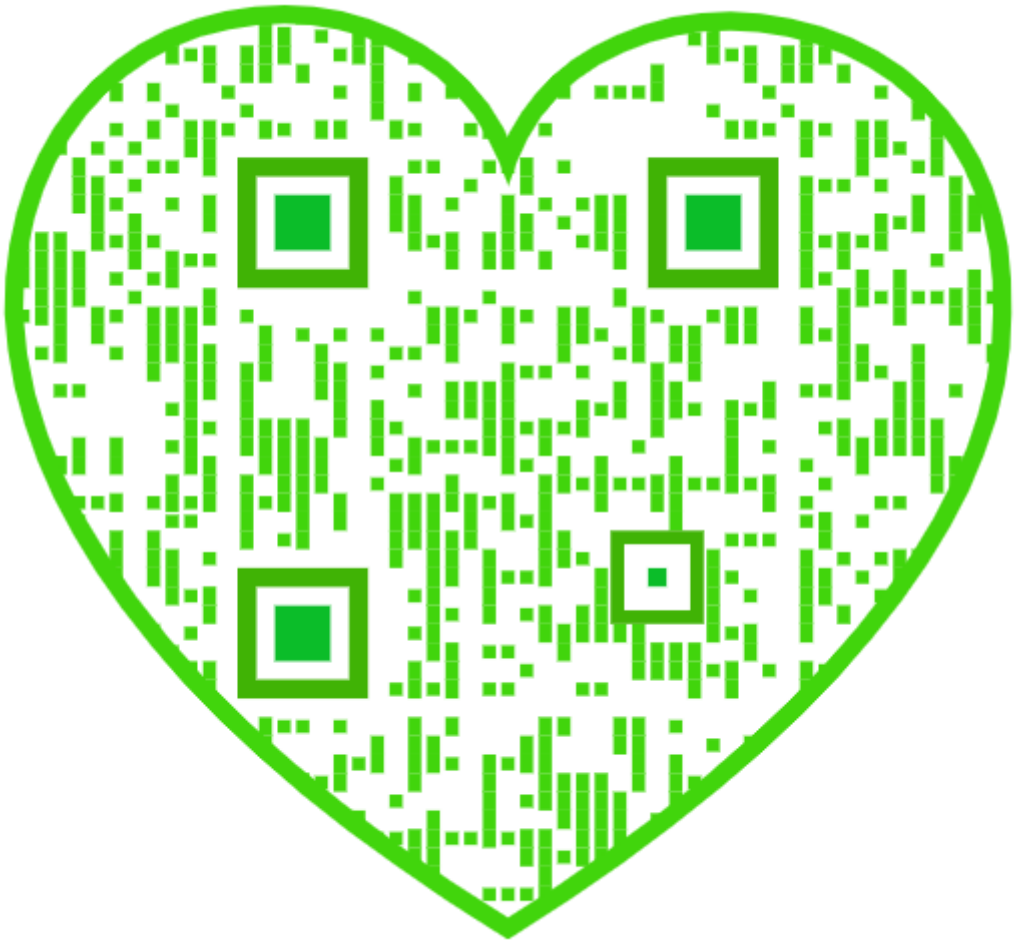

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THE BLUEBERRY IN THE ATLANTIC PROVINCES

BLUEBERRY CULTURE AND PROPAGATION

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INTRODUCTION

The blueberry, one of the most relished of the native fruits, has been an important item of diet in both eastern and western Canada since the coming of the first white settlers. Reliable estimates of the acreage of native lowbush blueberries available for commercial harvesting are difficult to obtain. Many areas included in early surveys have become so covered with brake fern and other weeds that management and harvesting on a commercial scale is difficult, if not impossible. Some of these fields may become productive again, but most are reverting to forest.

Blueberry stands are often irregular, scattered among woodlots, waste land or fields of cultivated crops. Within the blueberry fields there are great differences in the completeness of the blueberry cover. Islands of swamp or brush, for example, often occur in otherwise productive fields. In the early days, blueberries were simply harvested as they grew in the wild. Although this is still the case in some areas, the number of carefully managed fields is increasing annually.

The estimated commercial production of blueberries for each of the five eastern provinces of Canada and the State of Maine, is given in Table 1.

Table 1.—Estimated lowbush blueberry production in the Atlantic Provinces, Quebec and Maine (thousands of pounds)[1]

	1954	1955	1956	1957	1958	1959
Quebec	19,702	17,642	4,875	3,085	2,917	
New Brunswick	3,500	3,000	4,100	3,300	2,500	3,500
Nova Scotia	5,126	3,000	4,020	4,800	2,900	5,000
Prince Edward Island	441	394	133	300	300	600
Newfoundland	2,115	481	594	999	1,643	917
Maine	.....	16,000	16,500	29,400	16,300	22,900[2]

[1]Supplied by workers in the respective provinces and state.
[2]Includes imports.

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During the six years represented in this table the price in the Maritime Provinces varied from 10 to 12 cents per pound. Somewhat higher prices have sometimes been secured in Quebec. Specially graded berries from Newfoundland have also commanded a premium. Among fruit crops in the five eastern provinces, the revenue from blueberries is second only to that from apples. Figures such as those in Table 1 do not tell the whole story since records of the amounts harvested for local sale and home consumption are not available. Money from blueberries is particularly important to the local economy since the crop occurs largely in areas where other sources of agricultural revenue are lacking.

Most Canadian blueberry shipments are of fruit of the wild or semi-wild lowbush type. Commercial production of the cultivated highbush varieties is in its infancy in Canada, although a few individuals, inspired by the success of the crop in the United States, have started plantations.

In the foreseeable future, any large expansion of the blueberry industry is likely to be limited to regions where the native berries are found.

THE LOWBUSH BLUEBERRY

Taxonomy and Development

Five kinds of blueberries grow wild in Canada. Four are lowbush types and the other is a highbush type. The fruits of all, with the possible exception of ground hurts, are harvested and sold commercially. Botanically, they can be classed as follows:

SOURTOP *(Vaccinium myrtilloides)* — This species can be distinguished by the fact that its leaves and stems are pubescent and the margins of the leaves are entire. It is the species most frequently found in woodlands and is the dominant species in blueberry fields recently developed from woods, although it tends to be eliminated by repeated burning. It ranges from Nova Scotia to Vancouver Island, being confined in the prairie region to the more northerly areas.

GROUND HURTS *(Vaccinium boreale)* — The stems of this species are much branched and the plant grows prostrate. It is most abundant on the exposed headlands of Newfoundland, and is rarely found elsewhere in Canada.

SWEET LOWBUSH *(Vaccinium angustifolium)* — This variety has shiny, glabrous leaves with serrated margins, the point of which bear minute glands. It is the most abundant type of blueberry in stands developed on abandoned hayfields and in other fields that have been burned for many years. It ranges from Newfoundland to Manitoba.

BLACK LOWBUSH *(Vaccinium angustifolium* var. *nigrum)* — This variety can be distinguished by its blue-green foliage and black, shiny berries. Its range and habitat are similar to the sweet lowbush except that it tends to increase more rapidly with repeated burning.

HIGHBUSH *(Vaccinium corymbosum)* — The foliage and stems of this species are extremely variable, but typically the plants grow to a height of over three feet. It crosses freely with the sweet lowbush blueberry and in certain areas a complex of intermediate and parental types is found. Its range is from Nova Scotia to Ontario and it is found chiefly in or around the edges of bogs or swampy areas.

The sourtop and ground hurts are both diploid (24 chromosomes) species, whereas the other two lowbush types and the highbush species are tetraploid (48 chromosomes). This is important in pollination; although plants of species with the same chromosome number will effectively pollinate each other, crosses between species with different chromosome numbers rarely, if ever, set fruit.

When a blueberry seed germinates it forms a small root which later grows into a strong tap root system. (Figure 1). The shoots emerge shortly after the root pushes through the seed coat. A crown forms directly above the tap root and rhizomes develop from it later.

In mature plants most of the new shoots develop from dormant buds on the rhizomes rather than from the crown area. The rhizomes also give rise to additional roots, which may develop to a size and shape similar to that of the tap roots. If separated from the parent plant, a piece of rhizome with well developed roots is capable of continued independent growth. In moderately heavy sod, rhizomes grow an average of 2 to 3 inches per year. In areas with few competing plants, blueberry rhizomes have, however, been found to grow as much as 15 inches in one season.

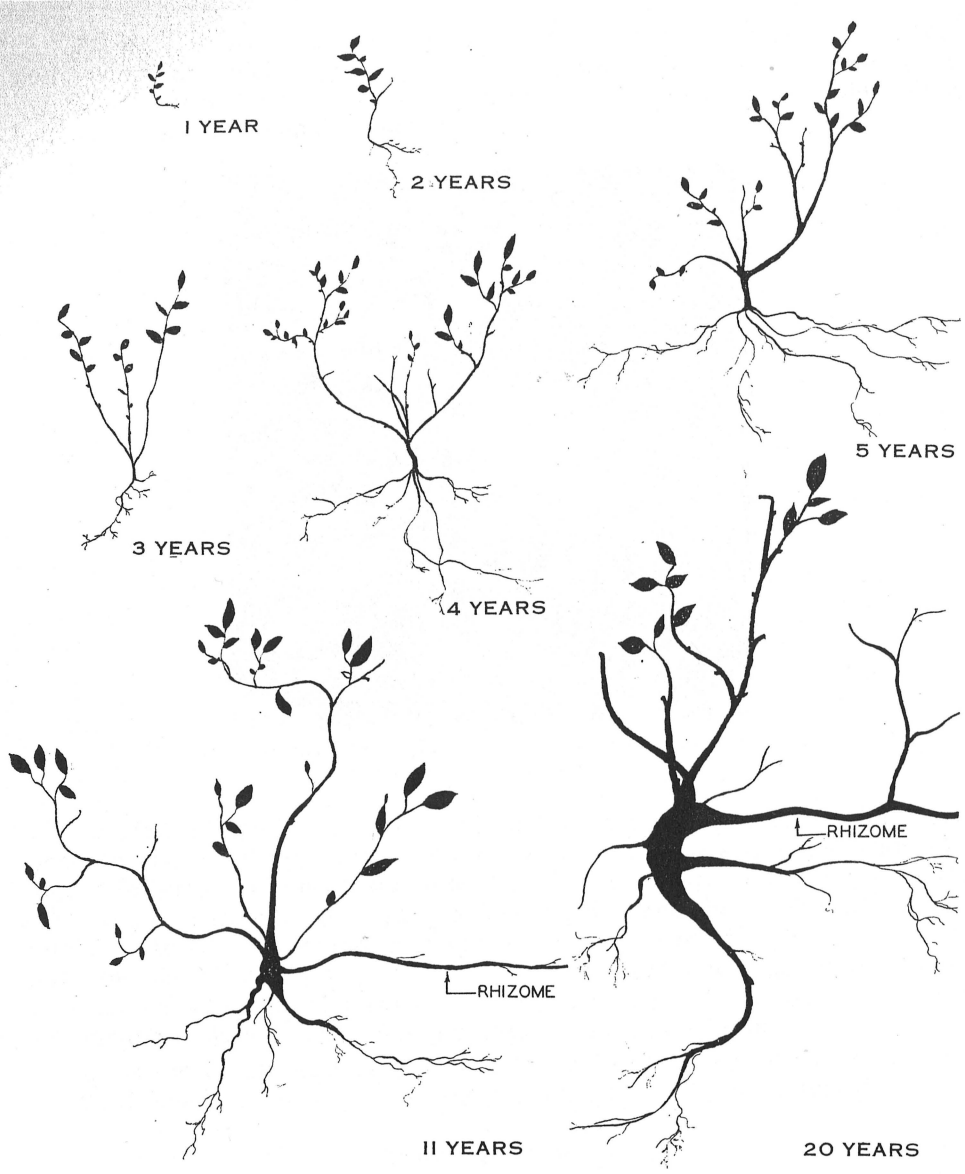

Figure 1—Plants of the lowbush blueberry developed from seed showing the relative sizes and forms at different ages.

Whether a particular bud will be vegetative or flowering is determined by mid-June of the year the shoot arises. By late September most, though not all, flower buds can be distinguished from vegetative buds as they are usually about three times larger. It is normal for the tips of growing shoots to die in mid- or early summer. The new growth in the following year then originates from lateral buds slightly behind the dead tips. The ratio of flower to vegetative buds is greater on new sprouts than on older twigs; the flower buds formed on new sprouts are also hardier and contain more flowers per bud.

Figure 2 shows the blueberry in flower. These flowers require insect pollination. Bumblebees and solitary bees work in colder weather than honeybees. Where wild bees are scarce the introduction of colonies of honeybees may increase the set of fruit.

Figure 2—The blossoms of the lowbush blueberry, approximately ¼ inch long, are pollinated by bees and other insects.

In New England and much of eastern Canada plants of the three common species, the sourtop (*V. myrtilloides*), the sweet lowbush (*V. angustifolium*) and the black lowbush (*V. angustifolium* var. *nigrum*), are found intermingled in the fields. The sourtop and the black lowbush are both rare in Newfoundland, and consequently the berries are much more uniform. Plants within a given species differ greatly in vigor and productiveness, color, shape and size of leaves; resistance to foliage disorders; and earliness, flavor, size, color, firmness and shape of fruit.

Superior plants can easily be selected. Unfortunately, however, no practical means of propagating and planting has yet been devised.

Soil Requirements

Lowbush blueberries are found on nearly every type of soil, but thrive on light, well-drained, acid soils. They rarely become established on heavy clay soils or where high general fertility encourages a dense cover of grasses or legumes. They occasionally grow wild in an acid layer of decaying plant debris overlying limestone soils. If these areas are plowed and the alkaline material is brought to the surface, the blueberries seldom grow again.

Although blueberry plants respond to applications of fertilizer, especially nitrogen, competing plants also grow more vigorously. Tests at Tower Hill, N.B., showed that this usually makes picking more difficult and often reduces the quantity of berries that can be harvested by the usual methods. At Avondale, Newfoundland, where there is only a thin soil layer

over ledge rock, and additional grass is needed to carry a fire, moderate applications of commercial fertilizer have stimulated the grass with no reduction in the crop of blueberries.

Under our present cultural methods, fertilizers are only helpful on soils of low fertility. No fertilizer should be applied without preliminary plot tests on the area involved.

Developing Blueberry Fields

Many of the blueberries produced in Quebec are gathered from land under timber lease, and on which fires are not permitted. Production in Newfoundland is largely on Crown land, where burning is done under the supervision of government officials. In contrast, most of the blueberries harvested in the Maritime Provinces are produced on carefully managed private holdings.

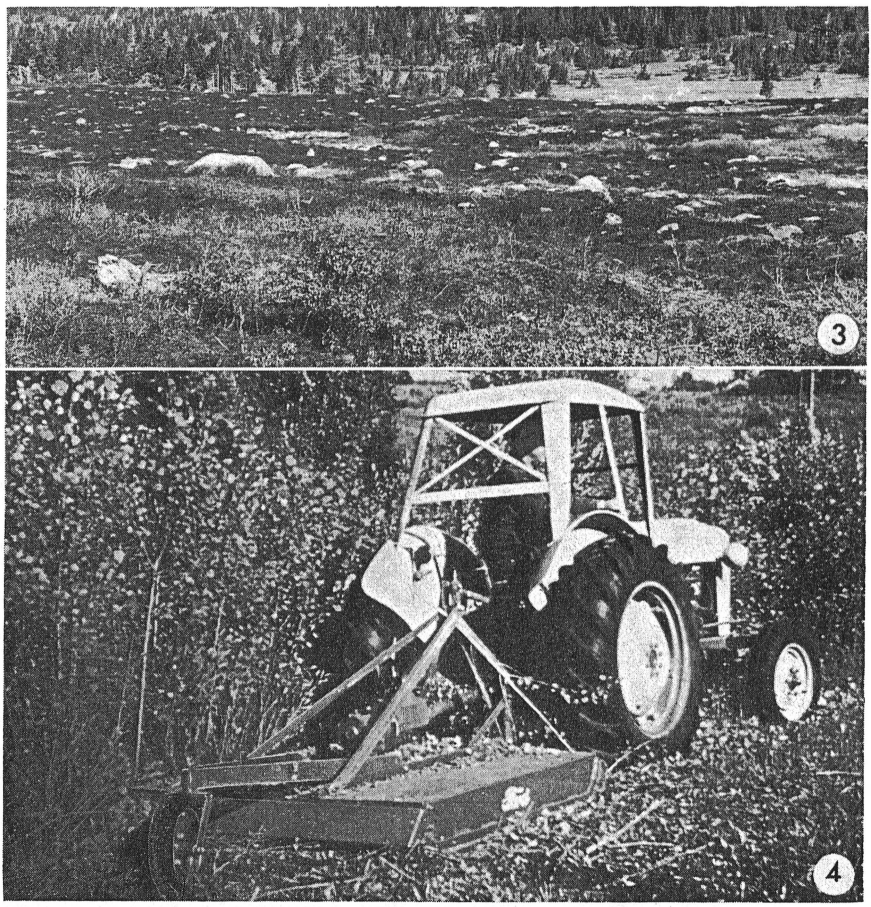

Figure 3—A blueberry field newly cleared from the forest.

Figure 4—Removal of brush and saplings before burning by use of a brush cutter attached to the power take-off of a tractor.

Blueberry management involves both the handling of established fields and the development of new fields. These new fields have only been successfully developed in areas such as abandoned hayfields and open woodlots where the blueberry is already established.

Figure 3 shows an area in which a scattered stand of white spruce and fir has been cut and burned, the brush having been piled on stone heaps for burning. This, along with the establishment of fireguards, is the first step in bringing this field into production. It is important to note that the brush was not piled on the blueberries for burning since the excessive heat would destroy them. Figure 4 shows a stand of blueberries, overrun by poplar, birch and maple saplings, being cleared with a rotary brush-cutter.

Stands of evergreens can be destroyed by a single cutting. With deciduous species, however, repeated cutting or treatment with a herbicide is necessary. The simplest situations are those in which blueberry plants develop in impoverished hayfields without the complication of tree growth.

Very few fields cleared directly from woods are completely covered with blueberries. The growth and spread of blueberries is encouraged and weed development is retarded by repeated burning. The length of time required to obtain a solid stand depends on the condition of the soil, the number of plants present and the degree of competition from weed species.

Figure 5—A stand of old blueberry plants showing numerous dead shoots.

Figure 6—A stand of vigorous new blueberry sprouts after an early spring burn.

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Burning

Strong new shoots are needed each year to ensure continued production. These can only be obtained by severe pruning. The use of fire is accepted as the simplest method of pruning out the old stems. Growers generally divide a holding into two or three sections, burning one-half or one-third in each year. The largest crop is usually produced the year following the burning and smaller crops each year thereafter. Burning may destroy the organic layer and lower the moisture-holding capacity of the soil. On the other hand, fire aids in controlling some insects and diseases. The long-term trend of yields in most districts is downward. How much of this is due to crowding, change of the flora in the field and causes other than fire is still uncertain. It is important to burn the entire area without leaving any "islands" since old plants provide refuge for many insect and fungus pests. They are also less productive.

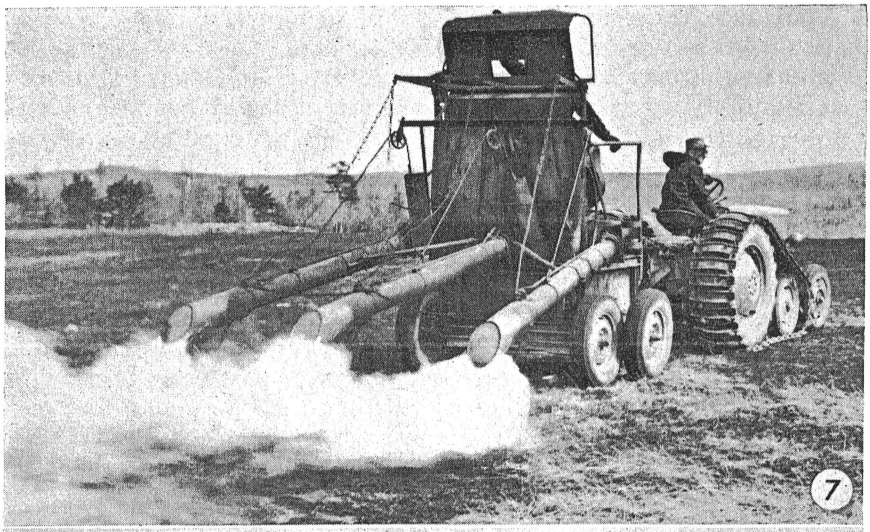

Figure 7—Burning in a lowbush blueberry field with an oil burner. This type of machine works well on smooth land.

Figure 8—An oil burner, mounted on a trailer with bombardier treads, will operate over extremely rough terrain.

A stand of old blueberry plants with numerous dead shoots is shown in Figure 5. Figure 6 shows the dense stand of new shoots that developed after burning.

In regions where systematic management is followed, growers often join together to do their burning. It is usually necessary to scatter straw or swamp hay at three-quarters to one ton per acre lightly over the area, as few blueberry fields have enough natural cover to carry a fire. The spreading operation is best carried out in the fall, after harvest, in preparation for a spring burn. In recent years a blower-type oil burner (Figure 7) has been introduced that can be used in slightly damper weather. About 40 to 50 gallons of stove or furnace oil per acre is normally required. Bombardier tractors and trailers (Figure 8) are useful on uneven land. To keep fire from spreading, a permanent fire guard such as brook, road or plowed strip is desirable around the edge of a field. If this is not possible, the best alternative is to burn a strip 10 feet wide around the field before the main fire is set. It is also important to have a plentiful supply of water on hand in brooks, ponds, barrels or cans. Back pumps holding two or three gallons of water are in common use for directing and controlling fires. Garden sprinkling cans are also useful, and many a fire has been stopped by a strong arm swinging a spruce bough dipped in water.

The maximum length of sprout and number of sprouts carrying flower buds is obtained if burning is done within a month after the snow melts. Very few sprouts appear on fields burned after July; flower bud formation has also ceased by this time. The plants in plots burned in late summer and fall produce normal sprouts the following spring. Either late fall or early spring burning is therefore recommended. It must be remembered, however, that in neither case will a crop be produced in the growing season following the burn. The usual practice in the past has been to burn one year in three, but in recent years many growers have burned in alternate years. Under the three-year plan, burning costs are less and more of the land is in crop each year. On the other hand, the second crop after the fire is seldom as heavy as that of the first year and is therefore more costly to harvest.

In areas where only natural cover is available for burning it may only be possible to burn at longer intervals.

Weeds

The lowbush blueberry is one of many plants forming a natural succession in the transition from open land to forest. As blueberries begin to establish themselves many weed plants such as kalmia (lambkill), hardhack, wild rose and other woody shrubs also appear. They compete with the blueberry for space, light, moisture and nutrients. Since so many weeds thrive with the care given the blueberry it is difficult to control them. Very few are killed by fire.

At Tower Hill it was found that annual cutting of plots in midsummer resulted in an increase in blueberries and a reduction in hardhack, wild rose, sprouts of hardwood trees and many other weeds. Spring and fall cutting gave no control. At Yarmouth, N.S., summer cutting also reduced sweet fern and brake fern.

Numerous chemical weed killers have been tested at Tower Hill, but all those effective on other shrubs also injured the blueberries. 2,4-D and

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2,4-5T, in dilutions recommended by the manufacturers, are very useful when spot-sprayed directly on the weeds without coming in contact with the blueberries.

Kalmia, also known as lambkill, or sheep laurel, is the most abundant and obstinate weed throughout the Atlantic Provinces and Maine. It has received and continues to receive special study. The most promising approach to selective control of this weed is based on the fact that blueberry leaves drop in early fall while the kalmia leaves remain green all winter. 2,4-D ester applied in the fall at 2 or 3 pounds per acre in 50 gallons of water penetrates the evergreen kalmia. The blueberry plants escape injury if burning is done either 3 to 4 weeks after growth stops in the fall or before it resumes in the spring.

Picking

Hand-picking is no longer used to any great extent in commercial production. It is sometimes practised if the fresh fruit is intended for a special market. In large scale harvesting, fields are commonly marked with twine in lanes 6 to 8 feet wide. Each picker is assigned a rake, a pail and a lane. When filled the pail is carried to the end of the lane where the berries are either cleaned immediately or emptied into shallow boxes to be trucked to the freezer, factory or shipping point. In good crop years a picker is expected to rake at least one bushel of berries per hour and is

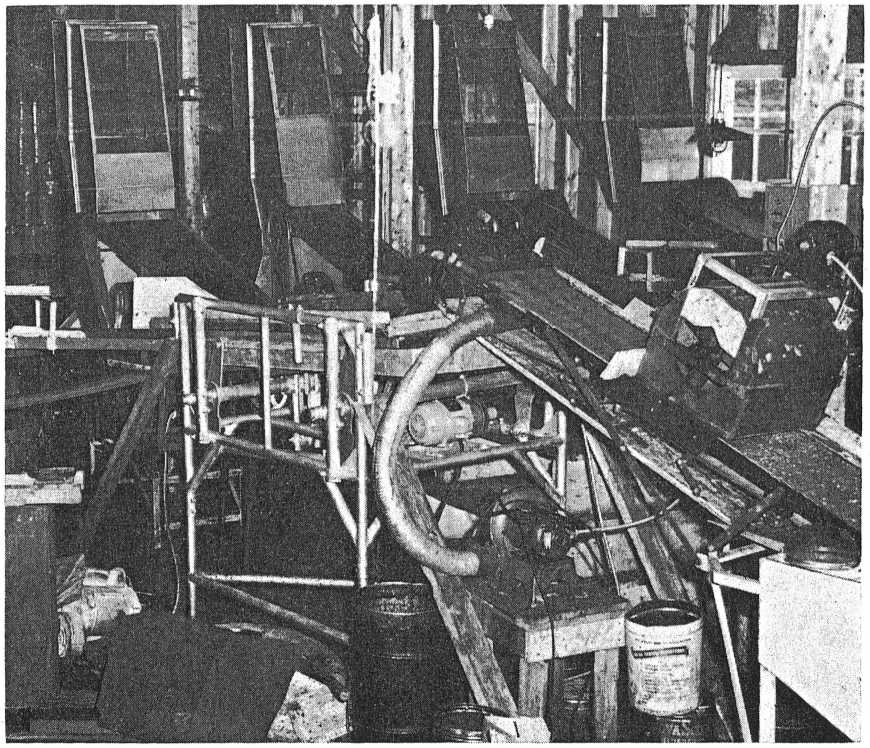


Figure 9—The interior of a lowbush blueberry cleaning plant showing four sorting machines, which receive the washed berries from an intake belt.

usually paid on a piecework basis. A supervisor in charge of each group of pickers can move the twine as needed, check the fruit from each picker, and make sure no fruit is missed. Portable field cleaners may be used with stacks of field boxes for each picker.

Efforts are being made to build satisfactory blueberry picking machines but none are yet beyond the trial stage. Almost all the berries reaching the market are gathered with rakes or scoops. These are made of sheet metal shaped somewhat like a heavy dustpan. The bottom is not a solid sheet; it is made of stiff spring wires, ⅓ inch apart, attached at the back. The wires are sharp at the forward (open) end, and form teeth. Rakes vary in width; most pickers prefer those with 40 to 50 teeth.

The picker runs the rake through the bushes in a forward and upward motion, like a scoop. The teeth catch the berries which collect in the bottom of the rake.

After the berries are gathered, twigs and leaves are removed, either by small fanning machines in the field or by larger equipment in central assembly plants (Figure 9). Green berries are removed by hand as they pass along a conveyor belt.

Uneven ripening of the fruit on the same or neighboring clones is often a source of loss. Green berries are not acceptable to canners, freezers or fresh fruit dealers. Their removal results in the loss of clusters containing green and ripe berries. Picking is usually delayed until fruit on the later clones is ripe, although many early berries may be lost. However, picking must be done before severe frosts as frozen berries rapidly become soft and tasteless.

THE HIGHBUSH BLUEBERRY

The original planting of varieties of highbush blueberries at Kentville was set in 1926 and is still productive and vigorous. The plants vary from about 4 feet for Harding and Greenfields to 7 or 8 feet for Katherine, Rubel, Grover and Adams. Single plants of the more productive varieties have at times yielded 15 or more quarts during one season, but averaged 4 to 6 quarts. (Figures 10 and 11).

The highbush blueberry has been grown in every mainland county of Nova Scotia and at several locations in New Brunswick. It thrives under cultivation in areas where the less hardy varieties of apples such as

Figure 10—Highbush blueberry plants 28 years old in bloom at Kentville.

Figure 11—Pint boxes of highbush blueberries. Pioneer, left, is an original variety; Berkeley, right, is a recent introduction. A comparison illustrates the progress made in blueberry breeding.

Gravenstein, King, Baldwin or Spy survive. Where winter temperatures frequently fall much lower than 20°F. below zero, protection is necessary, and this may limit commercial production.

Soil Requirements

Numerous tests conducted throughout the Maritimes during the past 20 years show that highbush blueberries can thrive on most fertile, well drained acid soils. Peats and mucks are generally unsuitable since they are usually wet in the spring and frost heaving occurs. Dense clays, compact loams, coarse gravels and soils with a hardpan near the surface are undesirable. Highbush blueberries develop a mass of fibrous roots near the soil surface. Since these are readily injured by drying, mulching is usually an essential. Excellent growth has, however, been obtained without mulching in a few locations where a well drained topsoil had a water table about 15 inches below the surface.

Soils with pH values of 5.0 to 5.5 have proved satisfactory. Little change occurs in the acidity of the soil beneath a mulch so that mulching does not serve to correct initially alkaline soils.

Varieties

EARLIBLUE — This is the earliest variety grown at Kentville. It is usually ready for a first picking by July 20 although the berries may be left on the bush until nearly all are ripe. The fruit is large and of good flavor.

BLUECROP — A few days later than Earliblue, this variety is likely to overbear unless carefully pruned. The fruit is large, firm, of fine flavor and ships well.

RANCOCAS — This early to midseason variety is inclined to overbear and needs severe pruning to maintain its fruit size. The fruit is of medium size, often uneven, and tends to split in wet weather, but is easily picked and the berries ship well. This variety is resistant to stunt disease.

JERSEY — A midseason variety, Jersey is productive, easy to prune and easy to pick, and has medium but uniform-sized berries that are firm to ship.

BERKELEY — A midseason variety with a vigorous and rapid-growing bush, Berkeley is easy to prune and a heavy cropper. The fruit is extremely large but lacks flavor and is not firm enough for long-distance shipping.

BLUERAY — A midseason variety, Blueray is somewhat slow to start fruiting, but is productive, and the berries are both large and of good quality.

HERBERT — This is a late variety. The bush is easy to propagate; it grows moderately well but is a bit slow to prune. The medium size fruit is attractive, has a perfect scar, keeps well in storage and ships well.

BURLINGTON — The bush of this late variety is easy to propagate and grows moderately well but is a bit slow to prune. The medium-size fruit is attractive, has a perfect scar, keeps well in storage and ships well.

COVILLE — The bushes of this late variety are vigorous, easily pruned and productive. The fruit is large and of fine quality. It is fully as late as Burlington and the berries are more acid but have not stood up as well in shipping tests.

Pollination

Two or more varieties should be included in a planting to ensure good pollination. The varieties named above appear to be compatible and to overlap sufficiently in their flowering dates to allow cross pollination.

Preparation of Land

If new land is to be used for blueberries it should be thoroughly cultivated and leveled at least a year in advance. Drainage, if necessary, should be taken care of at this time. A depth of at least 15 inches from the surface of the soil to the water level is needed in the growing season to provide space for root development. When old farm land is being prepared, a cleaning crop or summer fallow is suggested to destroy weeds and hasten decay of the sod.

Mulching

Early tests at Kentville showed the value of a sawdust mulch, three or four inches deep, around the blueberry plants. The sawdust appears to insulate the soil, reducing evaporation and thus holding essential moisture in reserve until used by the plant. Generous moisture supplies are needed during July and August to bring the berries to market size and force new twigs for the subsequent year's crop.

In practice, sawdust may be applied over all the land in a layer 3 or 4 inches deep. Weeds are temporarily checked by such an application. Cultivation must be resumed as weeds appear and the sawdust then becomes merged with the soil. It is usually necessary to apply the sawdust again after 8 to 10 years. With wide spacing of plants it is more economical to apply the sawdust in a circle or band around the plants. Such an application should extend slightly beyond the spread of the branches with more sawdust being added as the bushes become larger.

As an alternate procedure, the sawdust may be applied beneath the plants prior to setting. This can be accomplished by opening a V-shaped furrow approximately 18 inches deep along the row with a ditching plow, introducing about 3 bushels of sawdust at each planting site and returning the topsoil.

A third procedure that may be of value consists of the application of small amounts of sawdust, about one bushel per plant, as surface mulches, at 1 or 2-year intervals. By this means the planting can be established with less initial outlay. Frequent cultivation must, however, be practised for weed control.

Peat is unsatisfactory as a surface mulch but induces vigorous growth when applied in holes or furrows beneath the plants prior to setting.

Planting

Spring planting is recommended in eastern Canada although fall planting with large plants is usually successful. Two-year-old plants are preferable to younger ones. Four- or five-year plants can be transplanted but are too unwieldy for general shipment.

The spacing between rows and between plants in the row depends on the cultivating equipment to be used. Spacings of 10 feet by 10 feet permit cross-cultivation for many years. Lighter equipment is needed where spacing is 8 feet by 8 feet. Very little hand hoeing is required when plants are set in this way. Closer spacing will result in crowding and necessitates severe pruning; it is recommended, therefore, only for small garden plots

where most of the work can be done by hand. Other common planting distances are 8 by 4 feet and 10 by 5 feet, but where plants are set this close in the row, cultivation can only be done in one direction.

Since blueberry roots are easily injured by drying, as much soil as possible should be left on them and planting should be done speedily. As in all transplanting, the earth must be firmly packed around the roots to exclude air.

Cultivation

Clean cultivation is needed for the first year or two. At no time should the soil be worked deeply as the roots are close to the surface and easily injured. If cultivation among older plants is continued after late July the plants may fail to harden properly and may suffer from winter-killing.

Where only one-way cultivation is possible, a shallow grape plow or in-throw disc can be used in the spaces between rows in early spring, turning the soil away from the rows. The remaining strips near the plants should then be hoed by hand, the weeds being thrown on the plowed strips. Subsequent cultivations complete the destruction of the weeds. At the last cultivation, usually in late June or early July, the soil is thrown towards the plants with an out-throw or one-way disc. Mechanical hoes and other tools attached to an off-set draw bar permit working closer to the plants and lessen the area which must be hoed by hand. Annual weeds, or crops of oats or buckwheat sown after the last cultivation, occupy the ground for the remainder of the season. These help to mature the plants for winter, add humus, and prevent soil erosion.

Fertilizing

The roots of small plants or those newly set are easily injured by chemical fertilizer. Broadcast applications thoroughly mixed with the soil before the plants are set, are relatively safe. On new plantings it is desirable to delay surface applications until the plants are fully in leaf. The fertilizer should then be applied when there is little or no wind as the young leaves are sensitive to burn.

After the plants become established, annual applications may be made in early spring before the leaves appear.

Vigorous annual growth is needed to maintain production as the fruit is produced on the wood of the previous year. Such growth is stimulated by fertilizers high in nitrogen. The common 9-9-7 orchard mixture has given good results at Kentville. Where levels of phosphorus and potash are adequate, sulphate of ammonia alone may be used. A fertilizer that leaves an acid rather than an alkaline residue is believed to be desirable. Stable manure and poultry manure are not usually recommended as they are difficult to apply evenly, usually carry weed seeds, and are likely to cause late growth, which is susceptible to winter-killing. Sawdust, where applied, furnishes enough organic matter.

Pruning

Thorough and careful pruning is essential if a full crop of large fruit is to be secured. As with the lowbush type, the fruit buds for the following year are all produced on the new shoots. The removal of old branches is

necessary to force this new growth. Pruning serves a further purpose in reducing the number of fruit buds when more are present than the bush can mature.

Pruning should be done during the dormant season. During the first two years of growth the weakest branches only should be removed as too heavy pruning retards growth. Any fruit buds or blossoms which appear in this period should also be taken off to encourage vegetative growth.

In later years the following procedure is recommended:[1]

"The pruning treatment of the different varieties varies according to the character of their growth. Those producing many shoots from the base require more thinning out of this growth than those with a few shoots. Varieties branching freely need more top thinning than those with few branches. Varieties whose shoots have fruit buds in the terminal two-thirds or three-fourths require more cutting back than varieties whose shoots have fruit buds in the terminal one-third or fourth only.

"The following outline of pruning practice is given as a general guide, not as a set of rules:

"First, remove or cut back a few of the older stems. These stems, after they are 3 or 4 years old, tend to produce short weak shoots and small berries.

"Second, remove all branches which are so near the ground that their fruit gets dirty.

"Third, remove the shorter, weaker shoots to prevent crowding.

"Fourth, cut back shoots with too many fruit buds. Usually 3 or 4 buds on a shoot are enough because each bud produces a cluster of 8 to 12 berries. If more buds are left so many berries will develop that they will be small.

"Finally, cut freely to encourage new growth. If pruning the first time, seek expert advice."

Picking

The month of August is blueberry picking time at Kentville, although a few early varieties may be gathered in July and the berries of a few extremely late ones remain on the bushes until October.

Annual weeds or a cover crop in the way of pickers may either be mowed once or twice between pickings, or broken down with a disc.

The berry becomes blue some time before real maturity. It is desirable to delay the first picking until a fair quantity of the berries acquire full size and flavor. Weekly pickings should then be made during the remainder of the season. Rancocas, Jersey and Burlington are usually gathered in three pickings.

Since berries picked on rainy or dewy days do not keep well, picking is better postponed unless a ready market exists. The blueberry keeps well on the bush and picking is rarely so urgent that it cannot be done in fine weather.

The usual market container is the pint wood veneer box, covered with cellophane and packed in crates or flats. Rubber bands or strips of narrow gummed tape hold the cellophane sheet in place. Mature fruit carefully picked and packed in this way remains fresh and attractive for as long as a week at the usual summer temperatures. The life of the fruit can be extended several weeks by cold storage. Fruit for freezing is better left on the bushes until it is thoroughly ripe and sweet. Holding the berries for a few days in a warm room after picking greatly improves the flavor of the frozen product.

[1]Bailey, John S., Henry J. Franklin and Joseph L. Kelley. Blueberry culture in Massachusetts. Mass. Agr. Exp. Sta. Bull. 358, p. 13. 1950.

Propagation of Highbush Blueberries

Highbush blueberries can be propagated by means of stem cuttings or seed. The nursery practice of budding or grafting, common in the growing of tree fruits, is not suitable for general use in blueberry propagation. Budding can, however, be used as an aid in the multiplication of a new variety since shoots suitable for cuttings develop rapidly from buds placed on an established bush.

Hardwood Cuttings

Highbush blueberries are usually propagated commercially by means of hardwood cuttings. These are prepared during the dormant season from vigorous shoots of the previous year. The shoots are divided into cuttings four or five inches long (Figure 12), the basal cut being made just below a bud since rooting occurs more readily at this point. The terminal portion of the twig bears flower buds and should be discarded. After preparation, the cuttings should be tied in bundles and packed in damp peat or sawdust until planting time.

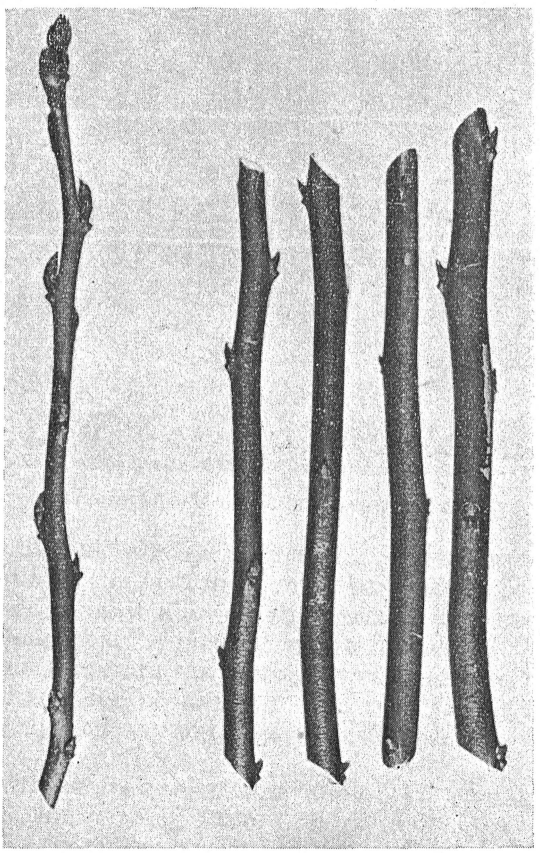


Figure 12—Hardwood cuttings from a single twig. The top portion of the one on the left should be discarded as the flower buds retard root formation.

Softwood Cuttings

Softwood cuttings can be taken in early July from the vigorous growth of the current year. They are prepared in the same way as hardwood cuttings except that two of the upper leaves are left and the cuttings are put directly into the propagating frames.

The Propagating Frames

The propagation bed suggested by Johnson[2] has proved satisfactory. It consists of a cold frame lined with tar paper to exclude air and covered with a tight glass sash and burlap shade (Figures 13 and 14). It has a wire-mesh bottom tray kept clear of the ground. The tray should be loosely filled with peat and the cuttings set two inches apart in rows 4 inches apart. One or two upper buds should be left above the peat and the base of the cutting should be approximately an inch above the wire screen.

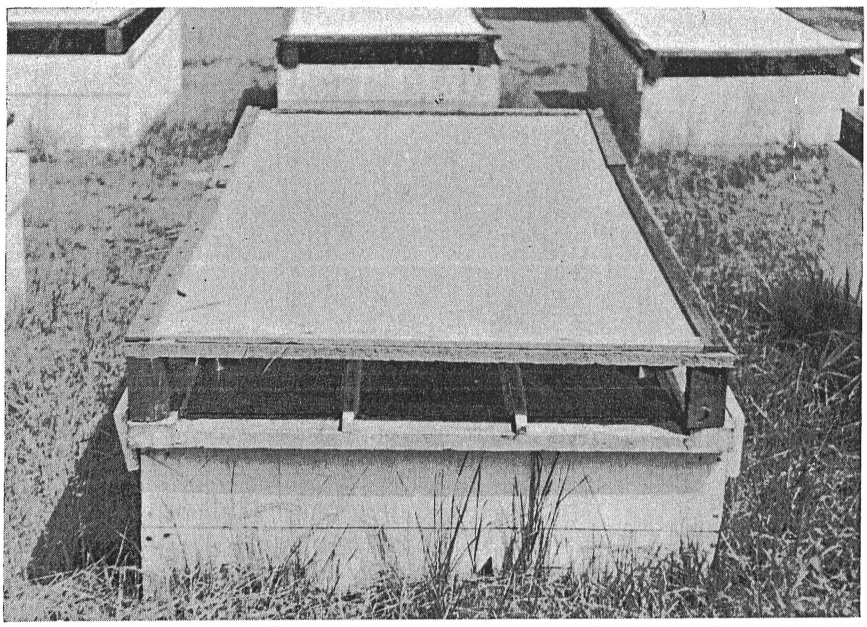


Figure 13—A closed propagating frame.

Dry peat moss will absorb very warm water immediately. If only cold water is available the peat moss must be broken up, watered, stirred, watered again and finally allowed to stand a day or two to become thoroughly moistened before placing in the frames.

Cuttings usually require six to eight weeks to root and seldom need watering more than once or twice in this time. Each frame should be examined frequently and any cuttings with drooping or discolored leaves removed at once.

After the cuttings are rooted they should be gradually hardened by lifting the shades for a short time, first on dull days, then for longer periods, and finally by full exposure. Heavier watering becomes essential as leaf growth continues.

[2]Johnson, Stanley. Essentials of blueberry culture. Mich. Agr. Exp. Sta. Circ. Bull. 188. 1947.

Recent experience at Kentville has shown that in this humid climate the tight-fitting frames are not essential. Cuttings set in undisturbed peat on the Caribou Bog at Aylesford and shaded with a 50 per cent lattice cover rooted excellently, with no loss from molds (Figures 15 and 16). At Kentville propagating frames covered with lattice have also proved satisfactory, but they require a cover to shed rain as excess water excludes air and rooting will not occur in saturated peat.

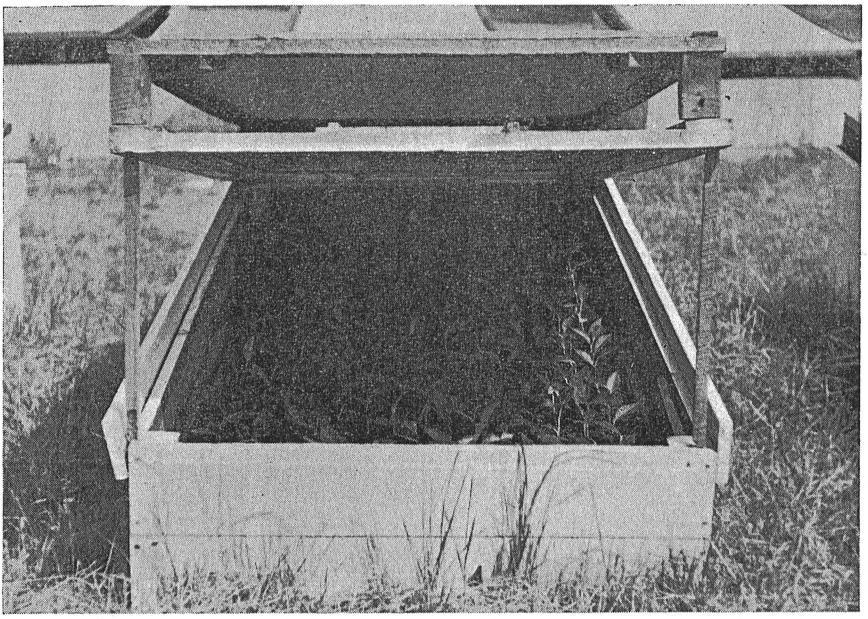


Figure 14—Hardwood cuttings in propagating frame. (Opened for photo only.)

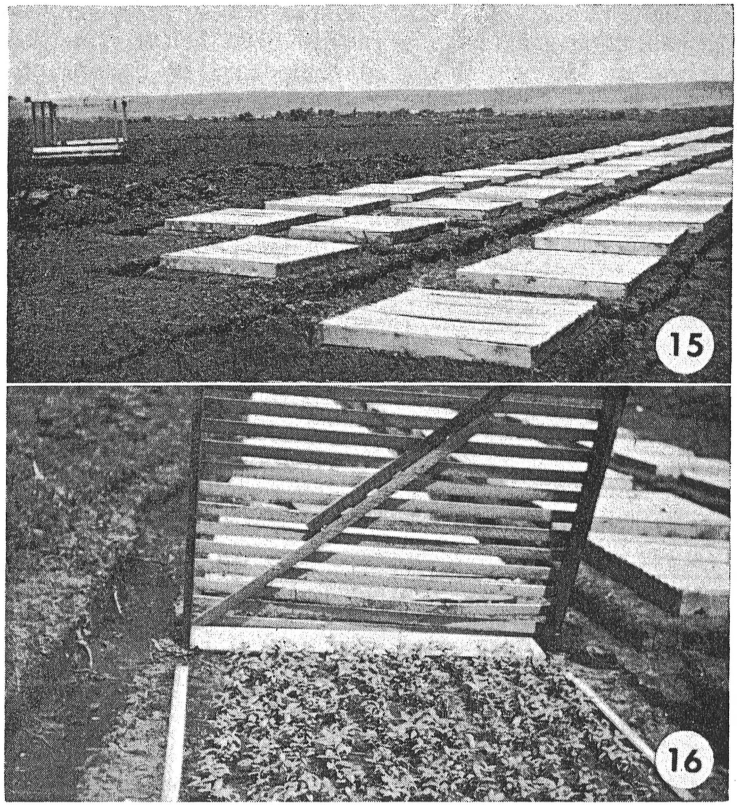
Winter Care of Rooted Cuttings

Hardwood cuttings are best left in the propagating frames over winter without protection. Softwood cuttings require special winter care since they are too tender to survive out of doors. The trays of softwood cuttings should be moved in the fall before severe frost to a cool, frost-proof root cellar for winter storage. The cuttings are ready for transplanting to special nursery beds in the spring.

Nursery Beds

Fertile clean land, either soil of high water-holding capacity or land which has received 3 or 4 inches of sawdust or peat, should be chosen for nursery beds. A broadcast application of 0-20-20 fertilizer at the rate of 1000 to 1500 pounds per acre, harrowed in before planting, is recommended. This should be followed by a side dressing of sulphate of ammonia at 100 to 200 pounds per acre after growth starts. Occasional watering during the summer may be necessary.

The rooted cuttings require at least a year in the nursery beds before transfer to their permanent location. If growth, however, has been retarded for any reason a second year in the nursery is desirable.



Figures 15 and 16—Propagating frames on undisturbed peat of the Caribou Bog, Aylesford, N.S.

Plants 12 to 18 inches tall are more satisfactory for field planting than those which are shorter, as the roots of small plants often remain in the dry topsoil and suffer from lack of water.

Seedlings

The propagation of the highbush blueberry by seed is only of interest to plant breeders. The seed grows freely if taken directly from the fruit, but on drying the seed coat becomes extremely hard and subsequent germination is often slow and irregular. Since the seeds mature before the pulp they may be collected from either ripe or partially ripe berries. The seed can be separated from the pulp either by thoroughly crushing the berries and washing repeatedly in water, or by rolling the berries with fine sharp sand.

To grow plants from seed, partially fill flats with fertile garden soil, level, and cover it with ½ inch of granulated peat moss. This should then be re-leveled, packed, thoroughly watered, and the seed (or seed and sand) scattered thinly over the surface. The seeded flats should be placed in a warm location and kept moist. Temperatures approaching 90 degrees F. are desirable at this stage. Under the best conditions 4 to 5 weeks usually pass before the first evidence of growth.

The seedlings grow slowly at first, but if they are started in August or September and carried over winter in a warm greenhouse, they are usually large enough to transplant to a nursery bed in early spring. These nursery beds should be of fine fertile soil mixed with about one-third peat, and located within reach of a garden hose for thorough watering.

INSECTS AND THEIR CONTROL

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Research Station, Fredericton, N.B.

Blueberry Maggot

The most important insect pest of blueberries in the Maritime Provinces is the blueberry maggot, *Rhagoletis mendax* Cn. The development of the larva, a small white maggot, within the berry causes premature ripening and breakdown. The presence of this maggot in fresh, canned or frozen fruit, although not injurious to health, is objectionable. It also affects the export of blueberries to the United States, were regulations prohibit the sale of infested fruit.

The adult fly is somewhat smaller than a house fly. It emerges from the soil in July, the emergence date varying slightly from year to year according to weather conditions. The egg is laid beneath the skin of the fruit. A few days later the maggot hatches and feeds in the fruit for about two weeks, when it drops to the ground and burrows into the soil where it remains for the winter. Most of the flies emerge the following year but a fairly large number remain in the soil for two winters and a few possibly even longer.

Control

Cultural practices usually must be augmented with insecticides to control the maggot. A dust mixture composed of 10 per cent monohydrated copper sulphate, 40 per cent calcium arsenate, and 50 per cent hydrated lime is recommended. Two applications should be made, the first when the blueberries are beginning to turn blue and the second about two weeks later. If it rains shortly after either application has been made, it should be repeated. In areas where the maggot is known to be a serious pest the dust mixture should be applied at a rate of about 6 pounds per acre. Some burning of foliage may result from this heavy application. Generally, on areas not heavily infested, 4 to 5 pounds per acre is enough. Power dusters of the type shown in Figure 17 are commonly used for the application of pesticides.

Black Army Cutworm

The black army cutworm, *Actebia fennica* (Tausch.) has caused serious losses to blueberry growers, periodical outbreaks occurring at intervals of several years. When an outbreak occurs it may strip the foliage of blueberries and several other associated plants. The black caterpillars are normally night-feeding, climbing cutworms, but, during heavy outbreaks when food becomes scarce and the caterpillars are well grown, they may develop the marching habit and feed night and day.

When an outbreak of these insects is suspected blueberry stands should be examined as early as possible in the spring. Producing areas, particularly those burned the previous year, should be carefully inspected in late April

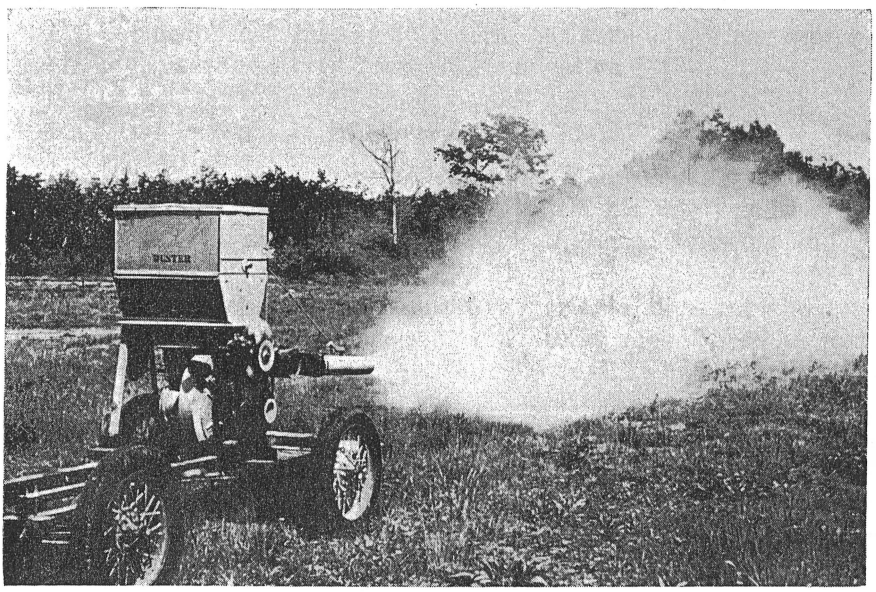

Figure 17—One type of power duster used in blueberry fields.

or early May. The caterpillars at this time are ¼ to ½ inch in length and feed principally on the terminal buds, eating out the interiors after entering through small holes that they make in the sides. Usually the outer bud scales are left intact and the entrance hole is inconspicuous. After a caterpillar has destroyed all or most of the buds on one stem it moves to another and continues its destruction. As the growth of the buds proceeds the contrast between injured and normal buds increases and infested areas become more easily detected. The caterpillars continue feeding until about the time the plants are in full bloom when they do extensive damage to the blossoms.

When the caterpillars are full grown they desert the blueberry plants and enter the soil where they eventually develop into moths which emerge, probably during August, to lay eggs. The insects are believed to spend the winter in the soil or surface debris as small caterpillars but possibly some may winter in the egg stage.

Control

A satisfactory way of examining blueberries for this insect is to sweep the plants at night with a stoutly made insect net. This may be constructed by using a hoop about 16 inches in diameter attached to a 5-foot handle, and with the open end of a cotton bag about 30 inches deep fastened securely to the hoop. The caterpillars are collected by sweeping the net back and forth across the tops of the plants as the observer advances slowly across the area under inspection. A count of the cutworms should be made following 50 sweeps, and if the number exceeds 25, control measures should be applied as soon as possible. If the number collected averages less than 12, control measures are usually not warranted.

Often other species of climbing cutworms are found in association with the black army cutworm.

A 3 per cent DDT dust at 30 pounds per acre or a 5 per cent dust at 20 pounds per acre has been found quite effective.

Blueberry Flea Beetle

The blueberry flea beetle, *Altica sylvia* Mall., usually causes damage in localized areas. Occasionally, however, it becomes fairly general. In 1947 it was abundant in many areas in southern New Brunswick and caused extensive injury.

The immature stage of this beetle is a black sluglike grub about ⅜ inch long when full grown. The insects overwinter as eggs. These hatch in the spring after development of the blueberry plants has begun, and the young grubs feed on the expanding foliage.

The adult beetle, which appears in early July, is roundish, shiny coppery-bronze in color, and less than ¼ inch long. Like all flea beetles it jumps suddenly when disturbed. Both grubs and adults feed on the blueberry foliage, eating out angular holes. The grubs feed readily on the blueberry blossoms and may damage them extensively.

Control

The grubs may be readily collected in an insect net such as that described for collecting the black army cutworms.

When they are first discovered the area should be dusted with 3 per cent DDT at about 30 pounds per acre. The first blueberry maggot application of 6 pounds per acre has proved entirely satisfactory for control of the adults of the blueberry flea beetle but this application is too late for control of the grubs.

Currant Fruit Weevil

In Nova Scotia the grubs of this small snout beetle, *Pseudanthonomus validus* Dietz, may develop in the blueberry fruits. The female deposits her eggs in the calyx lobes of the berries while they are small and green. The tiny grub which emerges from the egg in late June or early July is white in color with a light brownish head. It feeds on the pulp of the berry for about a month until full grown. It then changes to a white pupa inside the berry and remains in this stage for about 9 or 10 days. Usually when the first berries are ripe both the grubs and the pupae may be found, but within a week or 10 days practically all the grubs will have changed to pupae, and a week or so later most of the infested berries will have dropped.

In early August the adult weevils begin to appear. These are very small reddish brown beetles, somewhat less than ⅛ inch long, and have the long snout characteristic of weevils. The beetles feed on the berries, but unless they are numerous damage is negligible.

Control

The control of this insect on the blueberry has not been studied but observations suggest that it is not important on newly burned areas except when burning has been poorly done.

Chain-Spotted Geometer

The chain-spotted geometer, *Cingilia catenaria* (Drury), is an occasional pest of the blueberries in various parts of Eastern Canada where it may completely destroy the foliage and fruit under outbreak conditions. In addition to blueberry, it attacks many other plants commonly found growing on blueberry lands. Sweet fern appears to be its preferred food plant but rhodora, huckleberry, cranberry, wild spiraea and many others may be attacked. In severe outbreaks it may defoliate many species of deciduous trees and conifers after destroying the foliage of the low-growing plants.

The caterpillars are yellowish with prominent black spots along the sides, and when fully grown reach a length of 1½ to nearly 2 inches. Like all geometers or measuring worms, they move with a typical looping motion. The caterpillar stage occurs from early June until late in August. The moths, which are day fliers, may be found during September and October. They lay their eggs mostly on the leaves of sweet fern and other plants. The eggs overwinter in dead leaves on the ground. The moths may be distinguished by their smoky-white, almost transparent wings, the outer edges of which are marked by faint black lines and several distinct black spots.

Control

Treatments should be applied as soon as the insects are discovered. A 3 or 5 per cent DDT dust as recommended for the black army cutworm may be used.

Blueberry Thrips

Two species of thrips, *Frankliniella vaccinii* Morgan and *Iaeniothrips vaccinophilus* Hood, are commonly found on lowbush blueberry. In most fields the infestations are spotty but in some the thrips become major pests, and may reduce yields by more than 50 per cent.

The life histories of these two species appear to be similar, and it has not been possible to distinguish between the types of injury caused. The adults overwinter in the soil and emerge during late April or May. Only females survive the winter; they lay eggs in the developing leaf tissue in late May or June. Infested leaves fail to unfold normally and turn reddish in color. In sprout fields the leaves are mostly wrapped around the stem of the plant, while in crop fields one or more leaf rolls are formed. All stages in the life history of the thrips are passed within the curled leaves. New adults appear in July and August and soon leave the plant. The adult is yellowish gray in color and about 1/16 inch long.

Control

Blueberry thrips should be controlled during the sprout year since heavily infested plants bear little if any fruit during the following crop year. Infested areas should be dusted with 2½ per cent dieldrin dust at 20 pounds per acre when the sprouts are breaking through the soil.

Other Blueberry Insects

Various other species of insects may cause damage to blueberries but in general they are only of minor importance.

The blueberry tipworm, *Contarinia vaccinii* Felt, causes a rolling of the terminal leaves of infested plants. The injury caused by the tipworm is similar to that of the blueberry thrips but the leaf rolls are usually not as tightly folded as those injured by thrips, and the reddening of the foliage is less pronounced. Furthermore, the tipworm is most frequently found on *Vaccinium myrtilloides*, whereas the thrips prefer *V. angustifolium*. If one or more small maggots are found on injured foliage there is little doubt that the injury has been caused by the tipworm. Occasionally, however, both the tipworm and the thrips may inhabit the same leaf roll.

In some years sawfly larvae are fairly abundant in blueberry fields but their feeding does not seriously affect the crop. Of 19 species collected by sweeping only three species, *Neopareophora litura* (Klug), *Pristiphora idiota* (Nort.), and *Pristiphora* sp., feed on blueberry; the remainder feed on other plants growing in the blueberry fields. The larvae of those species that feed on blueberry are normally green but sometimes pink specimens may be found. Full grown larvae are about ¼ inch long. The peak of the feeding period is late May and early June.

A leaf roller, *Aroga trialbamaculella* (Chamb.), frequently infests sprout fields. Damage occurs from late August to October when the larvae fasten two or more leaves together with a silken web and skeletonize them from within the enclosure. Feeding is confined to leaves which would normally be shed within a short time and therefore their effect on the plant is considered negligible.

A stem gall formed by *Hemadas nubilipennis* (Ashm.), also is found on a few plants in most fields. Populations are very low, however, and this insect is not considered important.

DISEASES AND THEIR CONTROL

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Research Station, Kentville, N.S.

Twig and Blossom Blight

Twig and blossom blight occur on both highbush and lowbush blueberries following prolonged warm wet periods during May and early June. Two fungi have been found associated with blight on blueberries in Nova Scotia, New Brunswick and Quebec (*Monilinia vaccinii-corymbosi* (Reade) Honey and *Botrytis cinerea* Pers.). Symptoms of *Monilinia* blight are water soaked to dark brown areas and wilting of the affected leaves and twigs followed by a grayish-green mold. This produces spores that spread the disease. Affected blossoms turn brown and cling to the twigs. The fungus frequently attacks the young fruit, turning it into a mass of fungus tissue called a mummy berry. This mummy berry overwinters and in the spring gives rise to cup-shaped structures called apothecia. These liberate ascospores that infect the blueberry. Spores are produced for a few weeks or until dry weather prevents further growth of the fungus. *Botrytis cinerea* produces similar symptoms on the blueberry but does not have the mummy berry stage. Affected leaves are often a lighter brown than those affected with the *Monilinia* fungus. *B. cinerea* induces a soft rot of the blueberry fruit. The fungus overwinters on plant debris and continues producing its typical gray mold stage throughout the year.

The practice of burning lowbush blueberries every 2 or 3 years aids in controlling twig and blossom blight by destroying mummy berries, dead twigs and plant debris. Some mummy berries may be missed by the burning and become imbedded in the soil. It is these as well as those in headlands and border areas which produce apothecia (mummy cups) and ascospores to start a new infection. With the highbush blueberry, raking, hoeing or cultivation when the spore structures have started to form but before they have discharged their spores, have given fairly satisfactory control. This disturbs the overwintering mummy berries and stops further apothecial development.

Twig and blossom blight on the lowbush blueberry can be satisfactorily controlled by dusting with 10 per cent ferbam or 3.9 per cent zineb at 15 pounds per acre. The first application should be made at bud break and repeated at 7- to 10-day intervals until the end of the bloom period. Three applications usually give satisfactory control. If continuous wet weather occurs, however, four or five applications should be made. Ferbam or zineb may be applied when blueberries are wet.

Dust schedules are published annually by various provinces and copies may be obtained from your local agricultural representative.

Red Leaf

Red leaf is a systemic disease of lowbush blueberries caused by *Exobasidium vaccinii* (Fuckel) Wor. This disease appears in patches in blueberry fields throughout Canada from Newfoundland to British Columbia. It is most conspicuous during June and early July when the plants exhibit pronounced red to pink foliage. However, it may be occasionally found in late summer, especially on sprouts. During late June and early July a white feltlike layer of the fungus, bearing spores, forms on the under surface of the reddened leaves. By midsummer the affected leaves drop and the crop on these plants is usually very small. Red leaf disease spreads by airborne spores and also by mycelium through the rhizomes of affected plants.

Burning does not seem to control red leaf once the fungus has invaded the rhizome. The results of experiments on the use of fungicides and antibiotics have been inconclusive. Eradication of diseased plants constitutes the only means of control at present. This can be done by spot spraying with a mixture of 2,4-D and 2,4,5-T in water, at the standard rate for weed control.

Witches'-Broom

Witches'-broom is caused by the rust fungus, *Pucciniastrum goeppertianum* (Kuhn) Kleb. Multiple shoot production is stimulated by the fungus and a broomlike mass of swollen shoots results (Figure 18H). In the spring, spores produced on these swollen areas are carried to the balsam fir, where they infect the needles of the current year. Another type of spore, produced in small pustules on fir needles, infects the blueberry to produce the swollen shoots. The fungus growth is perennial in both the high and lowbush blueberry. The witches'-broom symptoms continue in the blueberry plant until it dies.

Fir trees near a blueberry field promote the disease by providing a source of infection. Removal of balsam fir from the vicinity of fields will therefore reduce the disease. Burning has little effect since infections usually become established in the crowns of affected plants.

Dieback

Following twig blight or winter injury, secondary or weakly parasitic fungi may attack the weakened shoots of highbush and lowbush blueberry and cause a dieback. Occasionally cankers are produced that kill the lowbush blueberry shoots to ground level.

A fungus (*Diaporthe vaccinii* Shear) is found in the imperfect or *Phomopsis* stage. It causes a dieback on blueberry shoots after they have produced a crop of berries (Figure 18G). Dieback can sometimes be serious in lowbush blueberries carried over for a second crop. When this fungus becomes troublesome in a lowbush blueberry field it is advisable to harvest one crop and then burn the stand. Affected parts of highbush blueberry plants should be pruned and destroyed.

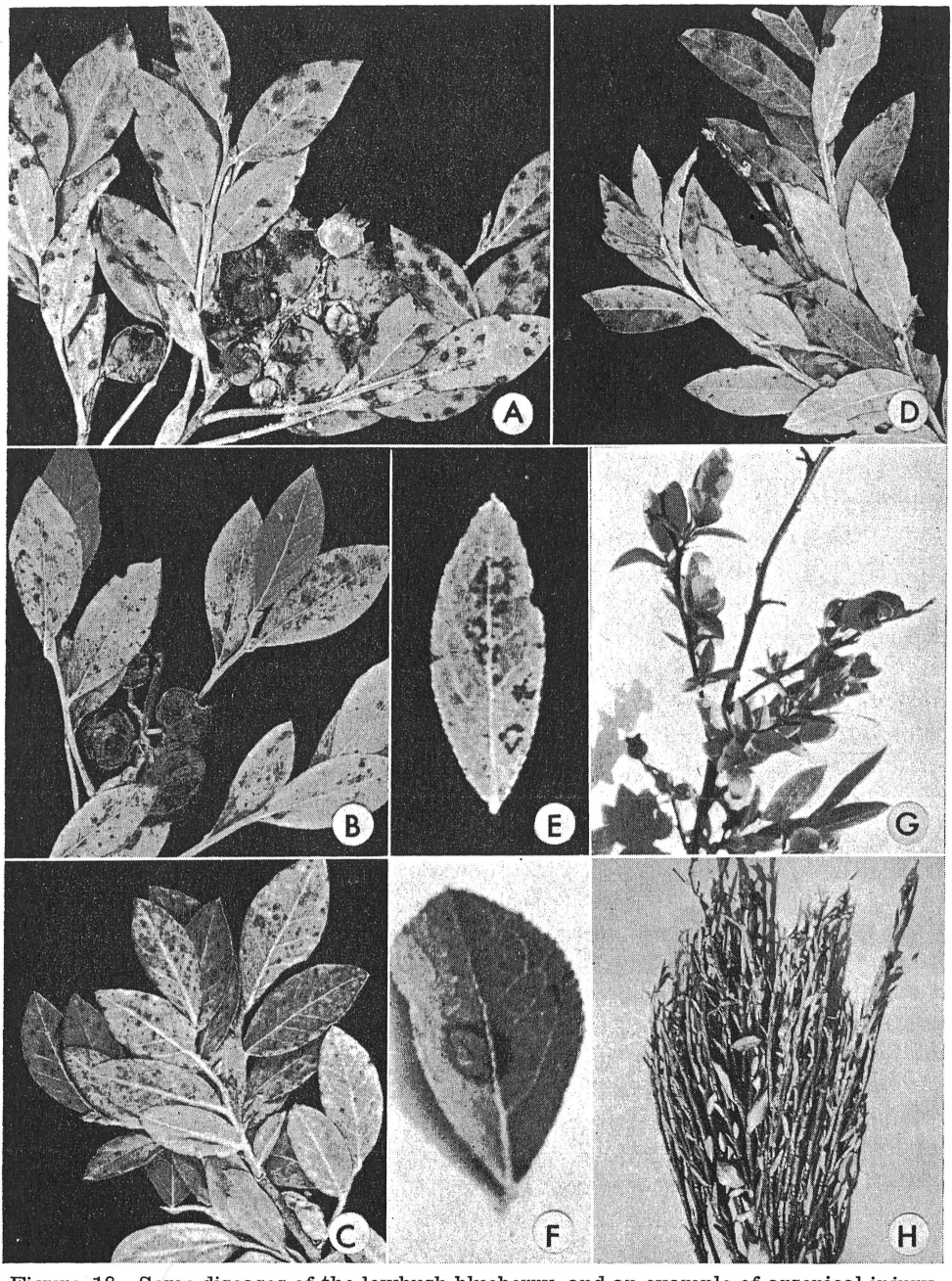

Figure 18—Some diseases of the lowbush blueberry, and an example of arsenical injury.
A—Brown spot caused by a species of *Septoria.*
B—Grayish-brown flecking or faint ring pattern spot.
C—Reddish to dark brown pinpoint spot.
D—Brown blotch spot.
E—Ring spot.
F—Arsenical injury.
G—Dieback caused by *Diaporthe vaccinii* on the tip of a 2-year-old shoot.
H—Witches'-broom caused by *Pucciniastrum goeppertianum.*

Mildew

In seasons of moist weather the mildew fungus (*Microsphaera alni* var. *vaccinii* (S.) Sal.) may attack the leaves of high and lowbush blueberry and cause a partial defoliation of the plants. Frequently the leaves turn red before falling but these are readily distinguishable from the red leaf disease by the lack of a white mat on their lower surfaces. Mildew is seldom serious enough to warrant control measures.

Leaf Rust

Leaf rust is a disease caused by a rust fungus (*Pucciniastrum myrtilli* (Schum.) Arth.) which passes part of its life cycle on the hemlock and part on either the highbush or lowbush blueberries. Affected blueberry leaves show light green areas on the upper surfaces. On the under surface of these light colored areas, rust colored pustules of spores will be found in September or later. Partial or complete defoliation may occur after harvest time when rust is sometimes abundant near hemlock woodlands. Leaf rust causes little damage to the blueberry due to the late appearance of the disease.

Leaf Spots

Two fungi of minor importance appear occasionally on the lowbush blueberry. One is a brown leaf spot caused by a species of *Septoria* (Figure 18A) and the other is caused by a species of *Gloeosporium*. The *Septoria* spot is somewhat irregular and is brown with small raised dots of the fungus scattered over its surface. Defoliation will occur when the disease is severe. The *Gloeosporium* spot is circular, brown to black, with white growth of the fungus appearing on its lower surface.

Other Leaf Diseases

Leaf spotting of unknown cause occurs on lowbush blueberries during midsummer and is more severe in the crop years. The spotting has appeared in the sprout year during prolonged dry weather or where blueberries are grown on light sandy or gravelly soils. Symptoms in the affected foliage are brown blotches (Figure 18D), or irregular grayish brown flecks which sometimes form a faint ring pattern with a green area in the center of the spot (Figure 18B), or a ring spot (Figure 18E), or a reddish to dark brown pinpoint spot (Figure 18C). Two or more types of spot may occur on one leaf. Unshaded leaves show more injury than those in the shade.

There is no known control treatment for leaf spotting.

Arsenical Injury

Arsenical injury (Figure 18F) appears either as brownish leaf spots with dark centers and red margins or as a marginal burning of the foliage. Since bracken ferns are particularly sensitive to arsenic, suspected cases of arsenical injury can often be verified by examining this weed for leaf burn.

Canker

A canker, caused by *Godronia cassandrae* Peck or *Fusicoccum putrefaciens* Shear, the imperfect stage, occurs on the highbush blueberry. It first appears as small reddish discolorations on the stems. As a canker enlarges the bark over the center turns gray, then brown, and finally the tissue dies. Usually the canker completely girdles the stem in one season. The disease is often noticed first when canker-girdled stems suddenly wilt and die during periods of dry, warm weather.

Infection occurs readily in the fall. Spring infections do not appear to spread until the blueberry ceases active growth. Pruning out affected plant parts several inches below the canker areas and destroying them gives a measure of control.

Stunt

Stunt, a virus disease of the highbush blueberry, reduces the length and vigor of new growth, moderately stimulates branching, and results in small unmarketable fruit. The leaves of affected plants are somewhat smaller than normal and turn reddish in late summer. Young leaves on new growth are paler than normal. The disease is spread by insects. Stunt can best be controlled by complete removal and destruction of affected plants as soon as they are identified.

Mosaic

Mosaic, another virus disease of the highbush blueberry, causes mottled leaves with yellow and yellow-green areas. Some leaves are yellow only along the margins of the major veins. Lower leaves may be yellow while the upper leaves may show no symptoms. The symptoms may vary with varieties and the mottle may become more brilliant and colorful as yellow areas turn various shades of orange or orange-red. Mosaic-affected plants should be pulled out and destroyed as soon as they are identified. The disease may be spread by insects.

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